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LAKE STATES FOREST EXPERIMENT STATION

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Forest Survey Staff. September 1946.

2 Postwar problems of the Cross Tie Industry in the Lake States. 8.10011
Arthur G. Horn and Harold F. Scholz. September 1946.

3 Estimating Cull in Northern Hardwoods. 7.15
W. M. Zillgitt and S. R. Gevorkiantz. November 1946.

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12 An Improved Increment-Core Method for Predicting Growth of Forest Stands. S. R. Gevorkiantz and Lucille P. Olsen. July 1948. 7.17

13 Forestry Situation in the Lake States. 0.9
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15, Supp. 1	Publications of the Lake States Forest Experiment Station, 1949-1951. Compiled by Helen A. Woodworth. January 1952.	0.1
16	Forest Fire Burning Conditions in the Lake States. John S. Crosby. March 1949.	3.1151
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22	Growth and Yield of Upland Balsam Fir in the Lake States. S. R. Gevorkiantz and Lucille P. Olsen. July 1950.	7.173
23	Reforestation Research Findings in Northern Wisconsin and Upper Michigan. J. H. Stoeckeler and G. A. Limstrom. December 1950.	2.50
24	Reducing Mortality in Old-Growth Northern Hardwoods through Partial Cutting. F. H. Eyre and F. R. Longwood. April 1951.	7.01
25	Changes in Forest Conditions 1936-1949, North Central Minnesota and Upper Peninsula of Michigan. (A Preliminary Analysis.) R. N. Cunningham. July 1951.	7.17 8.2

STATION PAPER NO. 1 SEPTEMBER 1946

REVISED FOREST STATISTICS FOR THE LAKE STATES 1945

FOREST SURVEY STAFF

R. N. CUNNINGHAM

REGIONAL DIRECTOR

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LAKE STATES FOREST EXPERIMENT STATION

UNIVERSITY FARM, ST. PAUL 1, MINN.

E. L. DEMMON, DIRECTOR

U. S. Department of Agriculture, Forest Service
Lake States Forest Experiment Station 1/

Station Paper No. 1 September 1946

REVISED FOREST STATISTICS FOR THE LAKE STATES - 1945

by Forest Survey Staff 2/

Basis for Revised Statistics

During the years 1934, 1935, and 1936, the Lake States Forest Experiment Station conducted a field survey of the forest resources of Minnesota, Wisconsin, and Michigan. These were published in a series of Economic Notes and one printed bulletin, USDA Misc. Publ. 429, "Forest Resources of the Upper Peninsula of Michigan."

In 1945, approximately 10 years after the original survey, the forest statistics were brought up to date by making deductions for the timber which had been cut or otherwise removed during the period and additions for the growth estimated to have accrued. Obviously these adjusted estimates cannot be as accurate as a new field survey, but they should serve many useful purposes. The record of actual drain from cutting, fire, and other losses for the 10-year period when considered in connection with the current growth and the remaining timber volume has real significance in indicating trends in the forest situation.

1/ Maintained at University Farm, St. Paul, Minn., in cooperation with the University of Minnesota.

2/ R. N. Cunningham, Regional Survey Director; S. R. Gevorkiantz, Silviculturist; Clarence Chase, Arthur Horn, Forest Economists; Paul Rudolf, Silviculturist. Assistance from Mr. Joseph Donery, Consultant for the American Forestry Association; from members of the Regional Office, Forest Service, Milwaukee; Forest Supervisors of National Forests; Forestry personnel of the State Conservation Departments of Michigan, Wisconsin, and Minnesota; Michigan School of Mines; Farm Foresters of the Soil Conservation Service, and from foresters of several paper and lumber companies is gratefully acknowledged.

Recognition should be given the fact that the areas and volumes of the original survey were for total forest area while those of 1945 are for a somewhat smaller commercial forest area.

The principal results of the timber resource reappraisal of 1945 are summarized in this paper.

Forest Areas

No significant changes have occurred in the total forest area of the region or of the individual states. The forest area is 55.7 million acres or 45½ percent of the total land area (table 1).

Some 1,138,000 acres of forest have been withdrawn from commercial use. This includes the wilderness areas on the Superior National Forest, the Porcupine Mountain State Park in Michigan, and numerous smaller park and resort areas. In addition, 4,217,000 acres are classified as non-productive or chiefly valuable for other than forestry purposes. Thus the commercial forest area is only about 50,345,000 acres.

Table 1.- Forest land area of the Lake States by states and classes of land - 1945.

State	Total land 1/	All Forest land 2/	Commercial Forest land 2/	Noncommercial forest land 2/		
				Total	Withdrawn from timber use	Chiefly valuable for purposes other than timber
	Thousand acres					
Minnesota	51,206	19,700	16,700	3,000	500	2,500
Wisconsin	35,018	17,000	16,265	735	86	649
Michigan	36,494	19,000	17,380	1,620	552	1,068
Total	122,718	55,700	50,345	5,355	1,138	4,217

1/ According to 1940 Census of Agriculture.
2/ Forest Survey estimate.

The classification of the area as between saw timber, pole timber, restocking, and deforested (table 2) has undergone some rather significant changes in the past 10 years. Because of heavy cutting, the acreage of land

bearing saw timber declined 653,000 acres and the area of pole timber declined 1,326,000 acres. On the other hand, the land classified as satisfactorily restocking increased more than 7 million acres while the poorly restocked and deforested area declined correspondingly. This filling in of young growth stands under improved fire protection is one of the most significant points brought out by the reappraisal. It forecasts a definitely improved condition for the region 50 or 60 years hence. Unfortunately, it does not provide additional merchantable timber volume for immediate use.

Table 2.- Condition of commercial forest land of the Lake States as shown by character of growth and area, 1945

State	Part of State	Commercial forest area	Sawtimber Area 1/	Pole Timber Area 2/	Seedlings & Saplings at least 40 percent stocked	Poorly stocked or denuded land
				Thousand acres		
Minnesota	North	13,480	1,230	2,460	6,250	3,540
	South	3,220	370	440	950	1,460
	Total	16,700	1,600	2,900	7,200	5,000
Wisconsin	North	9,980	920	2,010	4,430	2,620
	South	6,285	1,180	860	1,775	2,470
	Total	16,265	2,100	2,870	6,205	5,090
Michigan	U. P.	8,820	2,040	1,760	3,600	1,420
	L. P.	8,560	730	1,975	3,475	2,380
	Total	17,380	2,770	3,735	7,075	3,800
Region Total		50,345	6,470	9,505	20,480	13,890

1/ Lands with at least 2000 board feet of merchantable saw timber per acre, mostly in trees over 9 inch d.b.h.

2/ Lands with from 3 cords to 2000 board feet of merchantable wood per acre mostly in trees from 5 inch to 9 inch d.b.h.

Also see supplemental tables I to IIIa in the appendix.

Ownership of Forest Land.

Table 3 shows ownership of all forest areas while table 4 shows commercial forest ownership classified as to timber condition. About 43½ percent of the forest land in the region is owned by public agencies: Federal, State, county, or municipal.

AREAS BY SIZE CLASSES
LAKE STATES 1936-1945

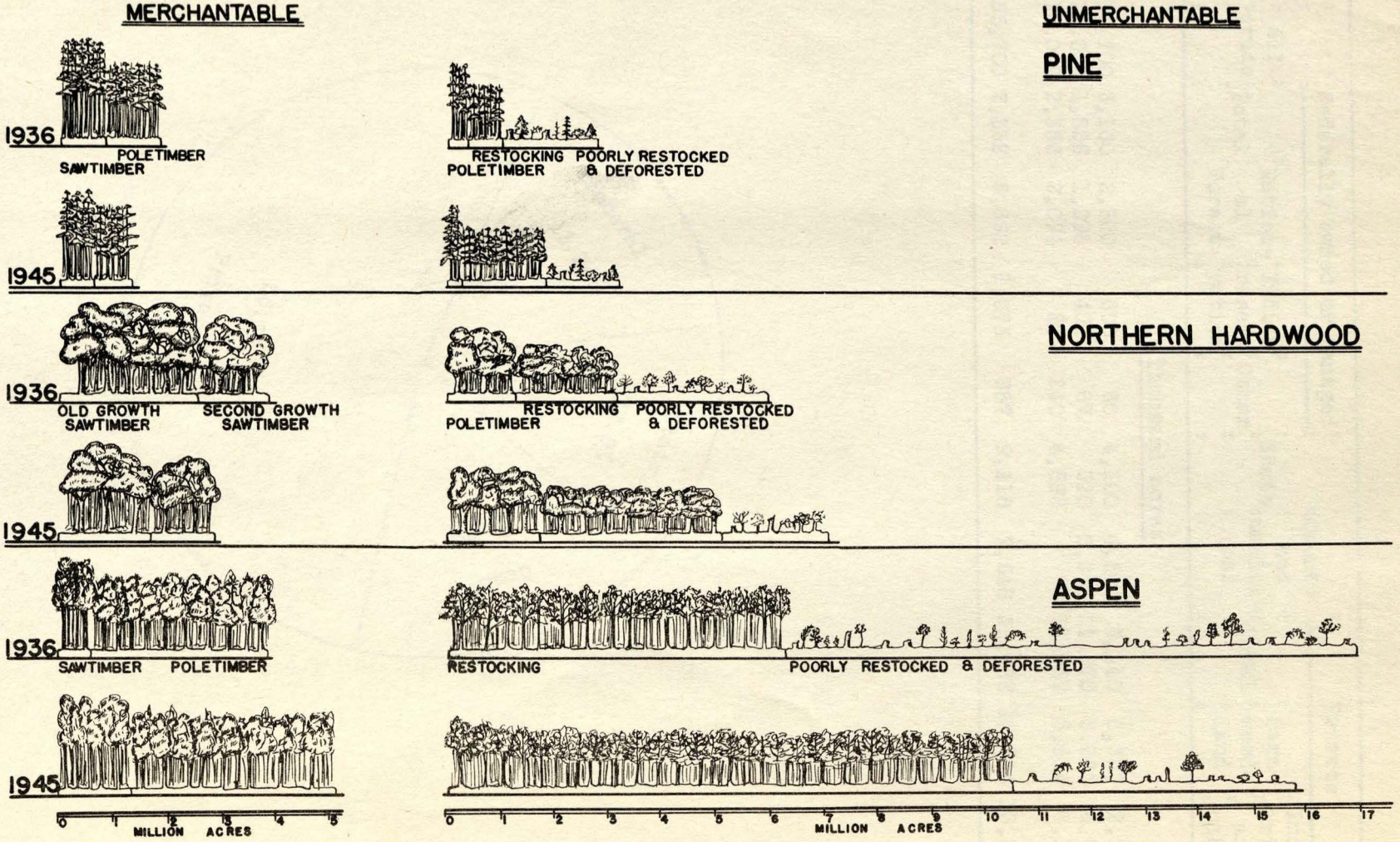


Table 3.- Ownership of all forest land in the Lake States - January 1, 1945.

State	All areas	Federally owned or managed				State	County and municipal	Private		
		Total	National Forest	Indian reservation	Other			Total	Farm woodland	Industrial and other
	Thousand acres									
Minnesota	19,700	3,160	2,500	600	60	4,100	4,300	8,140	5,383	2,757
Wisconsin	17,000	1,836	1,298	451	87	520	3,271	11,373	6,587	4,786
Michigan	19,000	2,356	2,094	22	240	4,598	77	11,969	3,814	8,155
Total	55,700	7,352	5,892	1,073	387	9,218	7,648	31,482	15,784	15,698

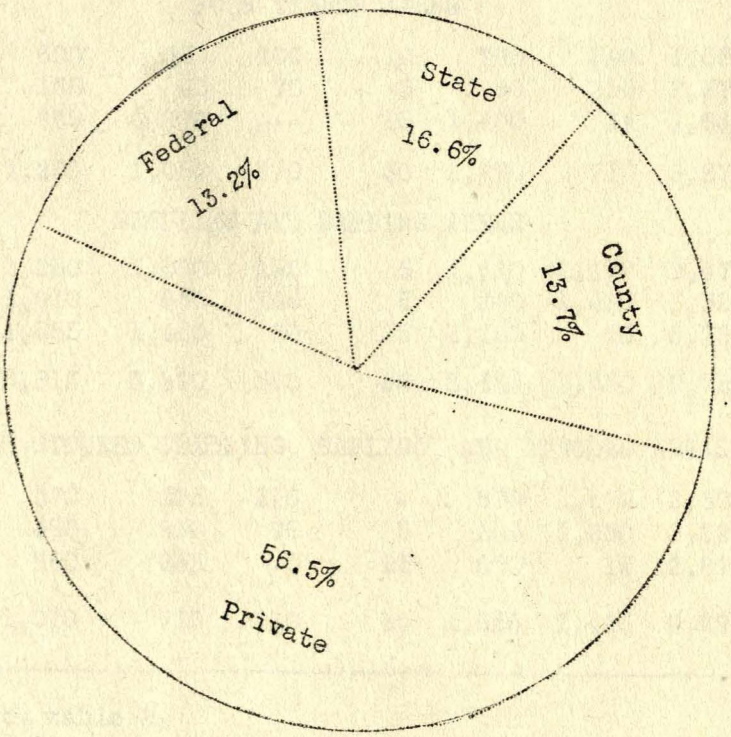


Table 4.- Ownership of COMMERCIAL forest land in the Lake States by condition classes - January 1, 1945.

ALL AREAS

State	Commercial areas	Federally owned or managed				State	Private			
		Total	Nat'l Forest	Indian Reservation	Other		County and municipal	Total	Farm woodland	Industrial and other
	Thousand acres									
Minnesota	16,700	2,670	2,170	485	15	3,300	3,800	6,930	4,330	2,600
Wisconsin	16,265	1,670	1,250	400	20	460	3,130	11,005	6,340	4,665
Michigan	17,380	2,155	2,035	20	100	4,050	65	11,110	3,260	7,850
Total	50,345	6,495	5,455	905	135	7,810	6,995	29,045	13,930	15,115
SAW TIMBER AREAS										
Minnesota	1,600	250	175	75	-	320	220	810	500	310
Wisconsin	2,100	115	20	90	5	35	65	1,885	1,135	750
Michigan	2,770	55	50	0	5	145	5	2,565	345	2,220
Total	6,470	420	245	165	10	500	290	5,260	1,980	3,280
POLE TIMBER AREAS										
Minnesota	2,900	800	690	100	10	700	340	1,060	670	390
Wisconsin	2,870	165	90	70	5	80	355	2,270	1,175	1,095
Michigan	3,735	285	270	---	15	1,490	15	1,945	525	1,420
Total	9,505	1,250	1,050	170	30	2,270	710	5,275	2,370	2,905
SEEDLING AND SAPLING AREAS										
Minnesota	7,200	1,250	1,050	195	5	1,410	2,070	2,470	1,210	1,260
Wisconsin	6,205	1,010	860	145	5	240	1,430	3,525	1,725	1,800
Michigan	7,075	1,555	1,480	20	55	1,765	30	3,725	750	2,975
Total	20,480	3,815	3,390	360	65	3,415	3,530	9,720	3,685	6,035
POORLY STOCKED SEEDLING, SAPLING, AND DENUDED AREAS										
Minnesota	5,000	370	255	115	-	870	1,170	2,590	1,950	640
Wisconsin	5,090	380	280	95	5	105	1,280	3,325	2,305	1,020
Michigan	3,800	260	235	0	25	650	15	2,875	1,640	1,235
Total	13,890	1,010	770	210	30	1,625	2,465	8,790	5,895	2,895

See definitions with table 2.

Table 5.- Commercial forest land by types and states.

Forest type	Region	Minnesota	Wisconsin	Michigan
		Thousand acres		
White pine	688	200	258	230
Red pine	516	180	141	195
Jack pine	3,089	1,240	764	1,085
Spruce fir	3,494	1,210	792	1,492
Black spruce	3,075	2,010	488	577
Tamarack	1,593	980	306	307
Cedar	1,629	550	295	784
Northern hardwoods	9,445	1,190	3,325	4,930
Oak	3,945	710	2,335	900
Ash elm	3,013	930	1,103	980
Aspen	19,858	7,500	6,458	5,900
Total	50,345	16,700	16,265	17,380

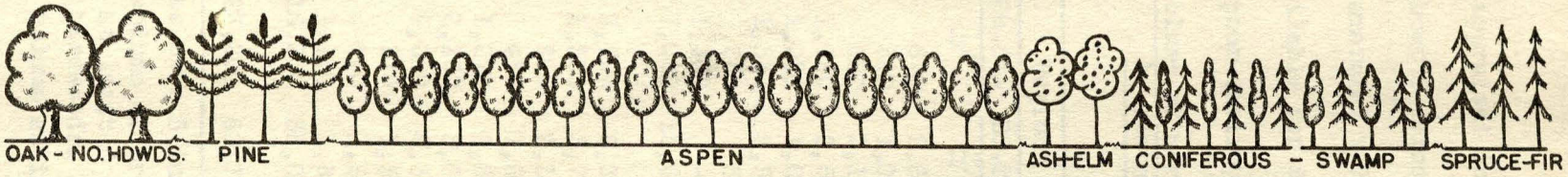
Table 6.- Commercial forest land by types and size classes.

Forest type	All size classes	Saw timber area	Pole timber area	Seedling & sapling area	Poorly stocked & denuded
			Thousand acres		
White pine	688	240	106	207	135
Red pine	516	109	80	269	58
Jack pine	3,089	226	614	1,170	1,079
Spruce fir	3,494	427	861	1,422	784
Black spruce	3,075	125	553	1,156	1,241
Tamarack	1,593	30	300	434	829
Cedar	1,629	163	316	624	526
Northern hardwoods	9,445	2,671	1,662	3,371	1,741
Oak	3,945	773	770	855	1,547
Ash elm	3,013	539	624	725	1,125
Aspen	19,858	1,167	3,619	10,247	4,825
Total	50,345	6,470	9,505	20,480	13,890

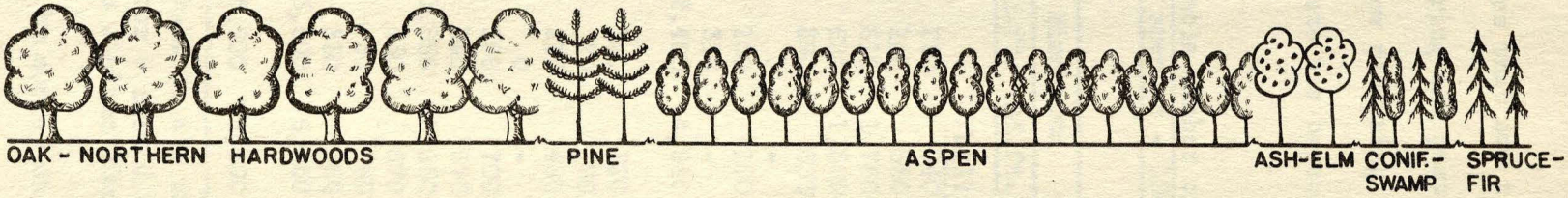
See tables I to IIIa in appendix for data on individual states.

1945 AREAS BY TYPES
LAKE STATES

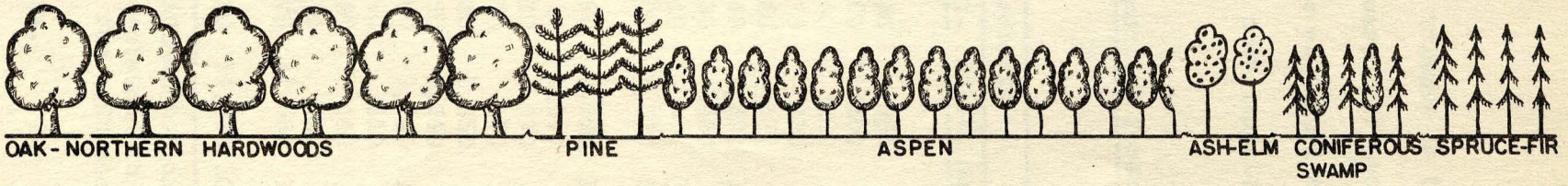
MINNESOTA

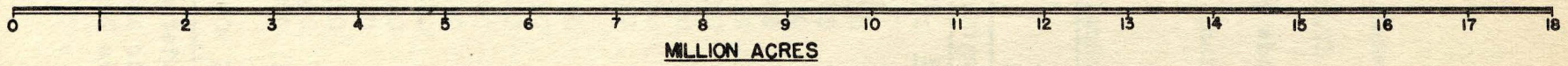


WISCONSIN



MICHIGAN





Timber Volumes

Saw timber

The 1945 appraisal indicates that saw timber volumes in the Lake States have decreased about 9 percent during the past 10 years. Of the 50.71 billion board feet of commercial volume now remaining, it is estimated that about 20 percent is unavailable for immediate use because of poor location, scattered occurrence, and poor quality.

Table 7.- Volume of merchantable timber on commercial forest lands by states and species - 1945.

Species	Region		Minnesota		Wisconsin		Michigan	
	Cu.ft. 1/	Bd.ft. 2/	Cu.ft.	Bd.ft.	Cu.ft.	Bd.ft.	Cu.ft.	Bd.ft.
				Millions				
White pine	670	2,640	230	840	230	930	210	870
Red pine	310	1,050	140	530	90	300	80	220
Jack pine	880	2,120	610	1,780	140	210	130	130
Spruce	1,050	2,550	620	1,360	70	230	360	960
Balsam fir	1,030	1,050	390	330	160	170	480	550
Hemlock	1,530	5,950	0	-	340	1,390	1,190	4,560
Tamarack	230	310	100	100	30	100	100	110
Cedar	1,300	-	310	-	240	-	750	-
All softwoods	7,000	15,670	2,400	4,940	1,300	3,330	3,300	7,400
Sugar maple	2,790	8,320	140	320	860	2,290	1,790	5,710
Yellow birch	1,350	3,730	20	90	510	1,040	820	2,600
Basswood	900	2,120	210	490	310	570	380	1,060
Beech	450	1,340	0	-	70	170	380	1,170
Elm	1,270	3,280	250	700	530	1,250	490	1,330
Oak	2,260	5,090	340	670	1,490	3,540	430	880
Aspen	4,360	6,380	1,850	3,250	960	1,240	1,550	1,890
Paper birch	870	1,360	430	670	190	310	250	380
Soft maple	840	1,580	30	80	290	440	520	1,060
Miscellaneous	1,110	1,840	230	380	490	800	390	660
All hardwoods	16,200	35,040	3,500	6,650	5,700	11,650	7,000	16,740
All species	23,200	50,710	5,900	11,590	7,000	14,980	10,300	24,140

1/ Volume of trees over 5 inch d.b.h. to a 4 inch minimum top diameter.

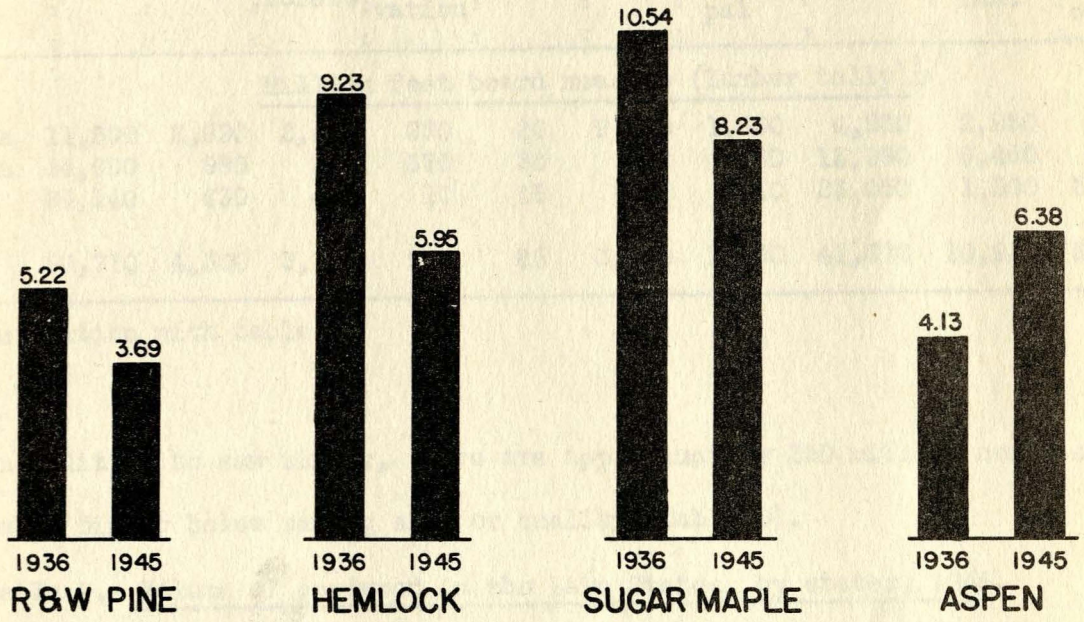
2/ Lumber tally volume of trees over 9 inch d.b.h. contained in logs at least 10 feet long and at least 6 inches minimum diameter for softwood and aspen and 8 inches for hardwoods.

See appendix for volume estimates by survey districts.

COMPARISON OF TIMBER VOLUMES

LAKE STATES 1936-1945

SAWTIMBER-BILLION BOARD FEET



TOTAL VOLUME - BILLION CUBIC FEET

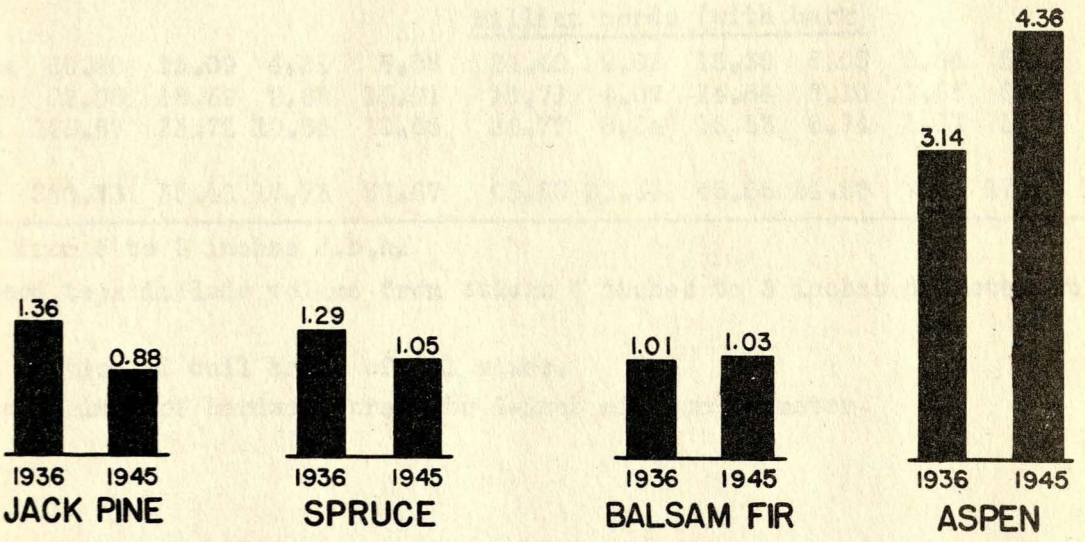


Table 8.- Ownership of saw timber stand on commercial forest lands in Lake States, by states, 1945.

State or subdivision	Total	Federally owned and managed				State	County and municipal	Private		
		Total	Nat'l forest	Indian Reservation	Other			Total	Farm woodland	Industrial and other
	Million feet board measure (lumber tally)[1]									
Minnesota	11,590	2,890	2,600	270	20	2,240	1,530	4,930	2,950	1,980
Wisconsin	14,980	980	280	670	30	550	360	13,090	6,460	6,630
Michigan	24,140	430	405	10	15	650	10	23,050	1,500	21,550
Total	50,710	4,300	3,285	950	65	3,440	1,900	41,070	10,910	30,160

1/ See definition with table 7.

Cordwood

In addition to saw timber, there are approximately 250 million cords of merchantable timber below sawlog size or quality (table 9).

Table 9.- Volume of cordwood in the Lake States, by states, 1945.

State	Total	Small sound trees[1] and softwood tops[2]									Cull trees[3] and hdwd. tops[4]
		Saw timber areas			Pole timber areas			Other forest areas			
		Total	Softwood	Hardwood	Total	Softwood	Hardwood	Total	Softwood	Hardwood	
	Million cords (with bark)										
Minnesota	68.20	13.09	4.21	8.88	24.40	9.02	15.38	8.09	2.44	5.65	22.62
Wisconsin	72.96	18.59	2.68	15.91	18.71	4.07	14.64	8.10	1.66	6.44	27.56
Michigan	109.57	23.72	10.84	12.88	26.77	8.24	18.53	8.74	3.11	5.63	50.35
Total	250.73	35.40	17.73	37.67	69.88	21.33	48.55	24.93	7.21	17.72	100.53

1/ Trees from 5 to 9 inches d.b.h.

2/ Softwood tops include volume from sticks 4 inches to 6 inches diameter at small end.

3/ Sound portion of cull trees of all sizes.

4/ Tops and limbs of hardwood trees to 4-inch minimum diameter.

Pulpwood volume

From 1936 to 1945, the volume of spruce and jack pine pulpwood declined sharply. Balsam fir increased somewhat, and aspen increased very greatly. Including aspen, the pulpwood inventory in 1945 was a little larger than in 1936 (table 10).

Table 10.- Net pulpwood volume[1/] - 1936 and 1945.

Species	1936	1945
	Thousand cords (with bark)	
Spruce	9,132	7,100
Balsam fir	7,646	9,100
Hemlock	3,600	3,000
Jack pine	8,340	5,300
Aspen	10,371	17,300
Total	39,089	41,800

1/ Excluding sawlogs and substandard cordwood.

The changes during the decade have not been caused entirely by growth and cutting. Estimates for spruce and jack pine in northeastern Minnesota were adjusted downward because newer and better information became available. Estimates for hemlock and aspen were increased somewhat because utilization standards were lowered in recent years.

The 1945 volume is divided between states as follows:

Table 11.- Net pulpwood volume[1/] - 1945 by states.

Species	Region	Minnesota	Wisconsin	Michigan
	Thousand cords (with bark)			
Spruce	7,100	4,400	400	2,300
Balsam fir	9,100	3,700	1,300	4,100
Hemlock	3,000	.....	500	2,500
Jack pine	5,300	3,100	1,100	1,100
Aspen	17,300	7,000	3,800	6,500
Total	41,800	18,200	7,100	16,500

1/ Excluding sawlogs and substandard cordwood.

Growth

Heavy cutting of pole size and even sapling size timber has curtailed normal increment and in some cases has prevented sapling stands from developing into pole timber and pole timber from growing to sawlog size. In the case of saw timber growth, therefore, present estimates indicate an average 20 percent less than previously estimated. In cubic foot growth, present estimates are 17 percent less than those made 10 years ago.

Table 12.- Average annual growth 1936 and 1945.

State	Species groups	Cubic feet[1]		Board feet[2]	
		1936 Estimate	1945 Estimate	1936 Estimate	1945 Estimate
		Millions			
Region	Softwood	247.7	178.5	565.7	346.4
	Aspen	329.3	336.3	295.5	407.6
	Other hardwoods	401.4	297.5	888.6	648.8
	All species	978.4	812.3	1749.8	1402.8
Minnesota	Softwood	137.1	101.1	272.0	176.4
	Aspen	133.7	142.6	145.6	144.4
	Other hardwoods	102.3	58.3	153.7	99.1
	All species	373.1	302.0	571.3	419.9
Wisconsin	Softwood	46.5	29.7	131.0	74.2
	Aspen	86.0	71.2	77.8	126.9
	Other hardwoods	149.5	114.7	389.4	262.6
	All species	282.0	215.6	598.2	463.7
Michigan	Softwood	64.1	47.7	162.7	95.8
	Aspen	109.6	122.5	72.1	136.3
	Other hardwoods	149.6	124.5	345.5	287.1
	All species	323.3	294.7	580.3	519.2

1/ Growth of trees over 5 inches d.b.h. to a 4 inch minimum top diameter.

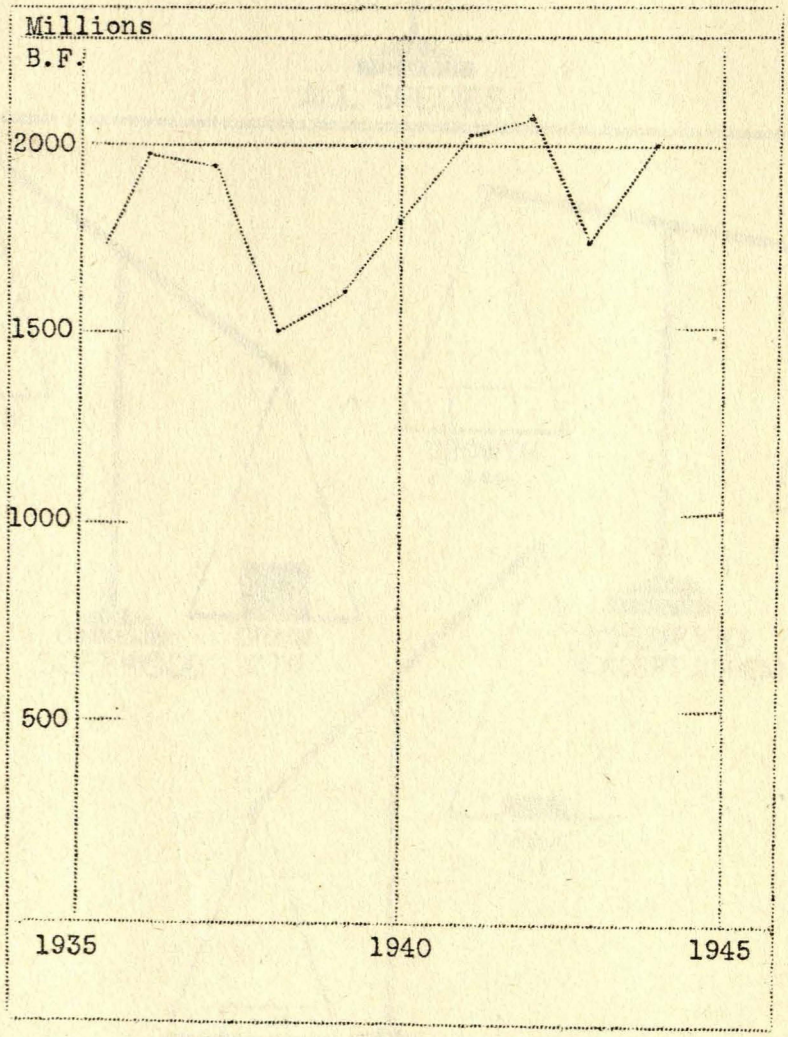
2/ Growth of trees over 9 inches d.b.h. to a 6 inch minimum top diameter for softwoods and aspen, and 8 inch minimum top diameter for other hardwoods expressed in board measure, lumber tally.

Drain

The average annual drain from 1935 - 1944 was 1,818,000 M board feet. During some prewar years it was as low as 1,500,000 M board feet, while during the war it rose to 2,000,000 M.

The drain by species is shown in table 13, and the agencies causing the drain in table 14.

DRAIN ON SAW TIMBER - 1936-44



SAWTIMBER GROWTH vs DRAIN

LAKE STATES 1935-1944

(FIGURES IN MILLION BOARD FEET)

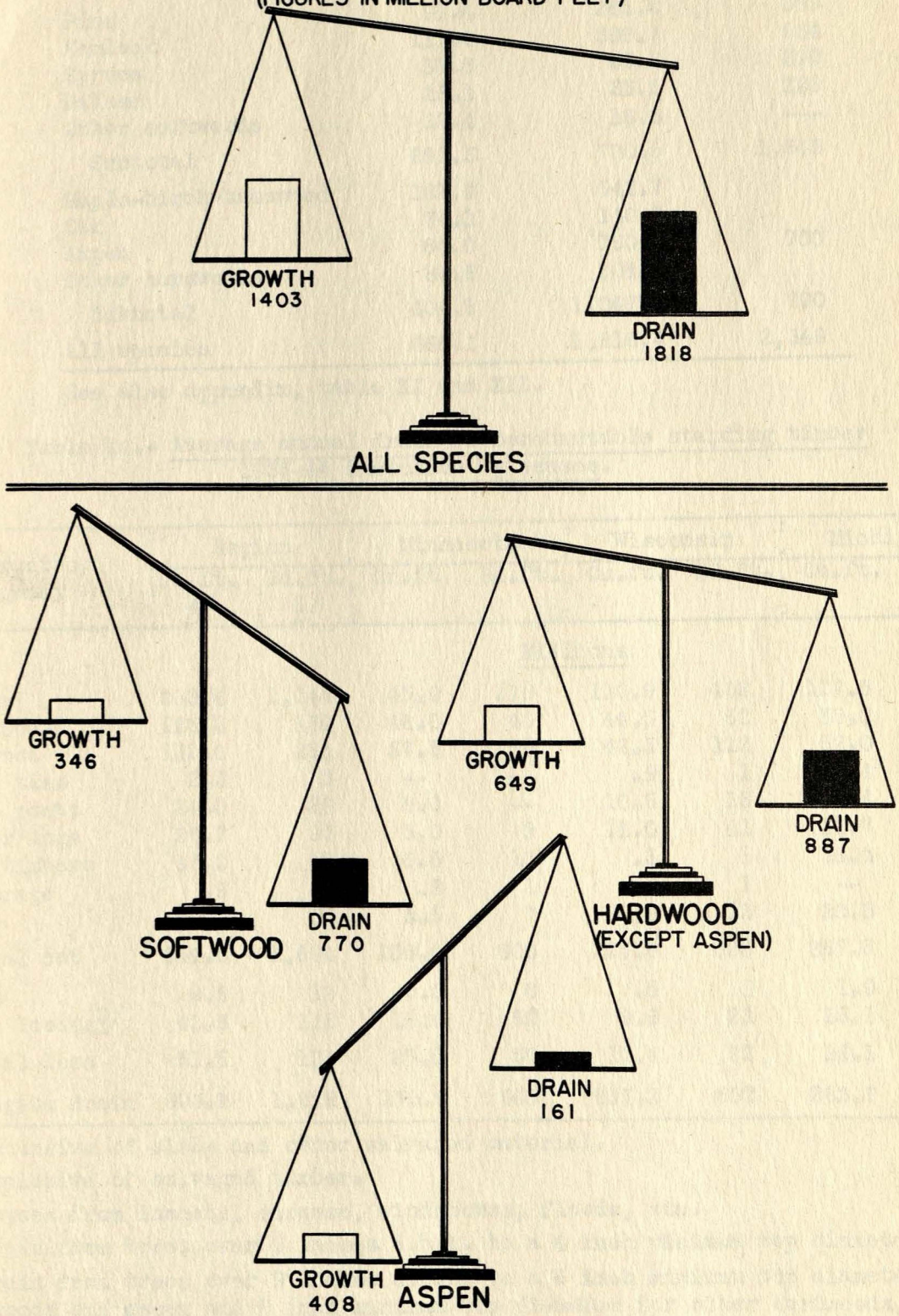


Table 13.- Average drain by species - 1935-1944.

Species	Total Volume cubic feet	Saw timber board feet	Pulpwood cords
	Millions	Millions	Thousands
Pine	91.4	265.4	389
Hemlock	111.6	399.7	664
Spruce	37.8	55.6	370
Balsam	23.1	33.5	226
Other softwoods	27.4	16.3	---
Subtotal	291.3	770.5	1,649
Maple-birch-basswood	161.9	542.7	
Oak	74.1	140.7	
Aspen	84.0	160.2	700
Other hardwoods	84.8	204.3	
Subtotal	404.8	1,047.9	700
All species	696.1	1,818.4	2,349

See also appendix, table XI and XII.

Table 14.- Average annual drain on merchantable standing timber 1935-44 inclusive by causes.

Product or agency	Region		Minnesota		Wisconsin		Michigan	
	Cu.ft. 4/	Bd.ft. 5/	Cu.ft.	Bd.ft.	Cu.ft.	Bd.ft.	Cu.ft.	Bd.ft.
	Millions							
Lumber	283.4	1,044	45.0	175	110.9	402	127.5	467
Fuelwood 1/	128.3	134	48.0	40	44.5	52	35.8	42
Pulpwood	132.0	281	37.5	50	42.5	112	52.0	119
Hewed ties	2.3	3	--	--	.9	1	1.4	2
Fence posts	24.0	20	6.0	--	10.5	13	7.5	7
Veneer logs	26.7	97	3.0	9	11.0	41	12.7	47
Mine timbers	17.2	47	6.5	18	.3	1	10.4	28
Cooperage	.8	2	.5	1	.3	1	--	--
Other	29.9	66	3.5	7	5.9	12	20.5	47
Total cut	644.6	1,694	150.0	300	226.8	635	267.8	759
Fire 2/	8.9	12	7.0	8	.9	1	1.0	3
Other losses 3/	42.6	112	18.0	52	9.5	21	15.1	39
Total loss	51.5	124	25.0	60	10.4	22	16.1	42
Aggregate drain	696.1	1,818	175.0	360	237.2	657	283.9	801

1/ Exclusive of slabs and other salvaged material.

2/ Exclusive of salvaged timber.

3/ Losses from insects, disease, windstorms, floods, etc.

4/ Drain from trees over 5 inches d.b.h. to a 4 inch minimum top diameter.

5/ Drain from trees over 9 inches d.b.h. to a 6 inch minimum top diameter for softwoods and aspen and 8 inch minimum top diameter for other hardwoods, expressed in board measure, lumber tally.

Allowable Drain

Analysis of present timber stands indicates that about 1,300 million board feet (646 million cubic feet) could be removed annually during the next 20 years without seriously impairing future growth possibilities. This could be accomplished by cutting fully mature stands and thinning or lightly cutting the second growth and pole stands. The period of liquidation should vary by species - about 10 years for aspen, 12 years for overmature jack pine, 25 years for white and red pine, 40 years for swamp types. In hardwoods, about half the merchantable volume is figured in the allowable drain during the 20 year period. Quantities are shown in table 15.

Table 15.- Allowable annual drain 1946-65 by states and species.

Species	Region		Minnesota		Wisconsin		Michigan	
	Cu.ft. 1/	Bd.ft. 2/	Cu.ft.	Bd.ft.	Cu.ft.	Bd.ft.	Cu.ft.	Bd.ft.
	Millions							
White pine	15.2	77.3	5.4	26.2	5.3	27.1	4.5	24.0
Red pine	6.0	28.0	2.8	15.8	1.7	7.4	1.5	4.8
Jack pine	37.4	88.6	28.6	82.5	4.8	4.4	4.0	1.7
Hemlock	36.8	114.4			7.8	20.9	29.0	93.5
Spruce	20.0	58.8	10.9	27.6	1.6	3.8	7.5	27.4
Balsam	26.8	27.9	10.2	8.9	4.0	2.4	12.6	16.6
Tamarack	3.7	5.0	1.7	2.0	.5	1.0	1.5	2.0
Cedar	23.1	--	5.4	--	4.3	--	13.4	--
All softwood	169.0	400.0	65.0	163.0	30.0	67.0	74.0	170.0
Sugar maple	64.0	161.8	2.9	7.4	19.1	45.9	42.0	108.5
Yellow birch	31.1	73.2	.5	1.7	10.9	20.0	19.7	51.5
Basswood	19.9	45.2	4.4	10.9	6.7	11.7	8.8	22.6
Beech	10.6	28.0	--	--	1.8	3.6	8.8	24.4
Elm	27.4	67.5	5.4	14.3	11.5	26.2	10.5	27.0
Oak	51.8	133.4	7.8	16.7	34.2	84.3	9.8	32.4
Aspen	199.6	272.7	83.3	141.9	33.3	38.8	83.0	92.0
Paper birch	29.1	37.6	14.5	21.0	6.1	6.6	8.5	10.0
Soft maple	19.9	31.3	.7	2.6	7.8	8.7	11.4	20.0
Miscellaneous	23.6	49.3	6.5	10.5	9.6	27.2	7.5	11.6
All hardwood	477.0	900.0	126.0	227.0	141.0	273.0	210.0	400.0
All species	646.0	1,300.0	191.0	390.0	171.0	340.0	284.0	570.0

1/ See footnote 4 of table 14.

2/ See footnote 5 of table 14.

A substantial proportion of the pulpwood volume in each state is in public ownership where it is subject to controlled cutting. Even some privately owned wood is too small and scattered to permit early cutting. Actually not more than 35 or 40 percent of the total volume of spruce should be cut in the next 20 years if the resource is to be properly maintained. Balsam fir grows more rapidly and consequently can be cut more heavily than spruce. However, on a sustained yield basis only about one-third the total volume is ready for use during the next 10 years. Certain areas of jack pine on the Superior National Forest are ready for heavy cutting immediately but elsewhere most stands are immature and should be thinned only lightly during the next decade. Hemlock is still fairly abundant in the Upper Peninsula of Michigan. However, the hemlock-hardwood stands in which this species occurs are being logged rapidly and hemlock does not restock the cut-over lands to any great extent. Aspen is the only species which can be exploited heavily in the near future. Unfortunately, the best remaining aspen is relatively inaccessible. Conversely, the nearby, easily loggable stands are mostly immature. If existing young aspen stands are handled properly, they can yield more than 2 million cords per year starting 5 to 10 years hence. The sustainable annual yield for these primary pulpwood species is shown in table 16.

Table 16.- Allowable annual cordwood drain of pulpwood species - 1946 - 1965.1/

Species : Region	:Minnesota	:Wisconsin	:Michigan
	Thousand cords (with bark)		
Spruce	130	80	15	35
Balsam fir	290	115	45	130
Hemlock	240	...	60	180
Jack pine	285	180	55	50
Aspen	2,040	800	350	890
Total	2,985	1,175	525	1,285

1/ Excludes sawlog timber but includes some rather low grade cordwood.

-- A P P E N D I X --

Table I.- Minnesota commercial forest areas by cover types - 1945.

Forest type	All size classes	Saw timber areas[1]	Pole timber areas[2]	Seedlings & saplings at least 40 percent stocked	Poorly stocked & denuded land
			Thousand acres		
White pine	200	80	20	60	40
Red pine	180	50	30	70	30
Jack pine	1,240	190	330	410	310
Spruce-fir	1,210	140	280	500	290
Spruce swamp	2,010	90	410	750	760
Tamarack	980	20	150	260	550
Cedar	550	40	130	180	200
Northern hardwoods	1,190	240	200	380	370
Oak	710	90	130	170	320
Ash-elm	930	110	150	300	370
Aspen	7,500	550	1,070	4,120	1,760
All types	16,700	1,600	2,900	7,200	5,000

1/ Lands with at least 2,000 board feet of merchantable saw timber per acre, mostly in trees over 9 inch d.b.h.

2/ Lands with from 3 cords to 2,000 board feet of merchantable wood per acre, mostly in trees from 5 inch to 9 inch d.b.h.

Table Ia.- Minnesota forest areas by survey districts - 1945.

Survey districts	All forest land	Commercial forest land				
		Total commercial	Saw timber area[1]	Pole timber area[2]	Seedlings & saplings	Poorly stocked or denuded
			Thousand acres			
1	6,600	5,870	440	1,030	2,910	1,490
2	6,060	5,650	590	1,060	2,600	1,400
3	2,570	1,960	200	370	740	650
4	2,340	1,910	230	230	560	890
5	2,130	1,310	140	210	390	570
State	19,700	16,700	1,600	2,900	7,200	5,000

See footnotes under table I.

Table II.- Wisconsin commercial forest areas by cover types - 1945.

Forest types	All size classes	Saw timber area[1]	Pole timber area[2]	Seedlings & saplings at least 40 percent stocked	Poorly stocked & denuded land
			Thousand acres		
White pine	258	85	39	76	58
Red pine	141	28	26	70	17
Jack pine	764	16	124	323	301
Spruce fir	792	52	186	315	239
Spruce swamp	488	7	43	146	292
Tamarack	306	1	29	89	187
Cedar	295	30	53	90	122
Northern hdwd.	3,325	785	625	1,181	734
Oak	2,335	587	436	465	847
Ash-elm	1,103	219	214	225	445
Aspen	6,458	290	1,095	3,225	1,848
All types	16,265	2,100	2,870	6,205	5,090

1/ Lands with at least 2,000 board feet of merchantable saw timber per acre, mostly in trees over 9 inch d.b.h.

2/ Lands with from 3 cords to 2,000 board feet of merchantable wood per acre, mostly in trees from 5 inch to 9 inch d.b.h.

Table IIa.- Wisconsin forest areas by survey districts - 1945.

Survey districts	All forest land	Commercial forest land				
		Total commercial	Saw timber area[1]	Pole timber area[2]	Seedlings & saplings	Poorly stocked or denuded
			Thousand acres			
1	4,580	4,490	490	820	2,090	1,090
2	5,700	5,490	430	1,190	2,340	1,530
3	4,650	4,335	630	560	1,335	1,810
4	2,070	1,950	550	300	440	660
State	17,000	16,265	2,100	2,870	6,205	5,090

See footnotes under table II.

Table III.- Michigan commercial forest areas by cover types - 1945.

Forest type	All size classes	Saw timber areas 1/	Pole timber areas 2/	Seedlings & saplings at least 40 percent stocked	Poorly stocked & denuded land
			Thousand acres		
White pine	230	75	47	71	37
Red pine	195	31	24	129	11
Jack pine	1,085	20	160	437	468
Spruce-fir	1,492	235	395	607	255
Spruce swamp	577	28	100	260	189
Tamarack	307	9	121	85	92
Cedar	784	93	133	354	204
Northern hardwoods	4,930	1,646	837	1,810	637
Oak	900	96	204	220	380
Ash-elm	980	210	260	200	310
Aspen	5,900	327	1,454	2,902	1,217
All types	17,380	2,770	3,735	7,075	3,800

1/ Lands with at least 2,000 board feet of merchantable saw timber per acre, mostly in trees over 9 inch d.b.h.

2/ Lands with 3 cords to 2,000 board feet of merchantable wood per acre, mostly in trees from 5 inch to 9 inch d.b.h.

Table IIIa.- Michigan forest areas by survey districts - 1945.

Survey districts	All forest land	Commercial forest land				
		Total commercial	Saw timber area 1/	Pole timber area 2/	Seedlings & saplings	Poorly stocked or denuded
			Thousand acres			
1	4,330	4,180	770	880	1,810	720
2	4,970	4,640	1,270	880	1,790	700
3	7,410	6,420	420	1,630	2,820	1,550
4	2,290	2,140	310	345	655	830
State	19,000	17,380	2,770	3,735	7,075	3,800

See footnotes under table III.

Table IV.- Minnesota saw timber volume by districts - 1945.

Species	State	Survey districts				
		I	II	III	IV	V
	Million feet, board measure (lumber tally)[1/]					
White pine	840	289	242	251	14	44
Red pine	530	62	313	106	13	36
Jack pine	1,780	1,268	380	78	8	46
Hemlock	-	-	-	-	-	-
Balsam fir	330	83	142	94	3	8
White spruce	350	66	148	134	2	-
Black spruce	1,010	568	155	254	1	32
Tamarack	100	4	50	33	9	4
Softwood	4,940	2,340	1,430	950	50	170
Sugar maple	320	11	106	-	150	53
Yellow birch	90	33	56	-	1	-
Basswood	490	1	172	8	230	79
Beech	-	-	-	-	-	-
Elm	700	35	146	78	294	147
Oak	670	30	70	2	389	179
Aspen	3,250	1,284	1,198	410	183	175
Paper birch	670	376	158	96	14	26
Soft maple	80	10	8	3	43	16
Miscellaneous better hardwood	30	3	11	1	13	2
Miscellaneous inferior hardwood	350	57	115	22	123	33
Hardwood	6,650	1,840	2,040	620	1,440	710
Total	11,590	4,180	3,470	1,570	1,490	880

1/ Volume of trees over 9 inches d.b.h. contained in logs at least 10 feet long and at least 6 inches minimum diameter for softwood and aspen and 8 inches for hardwood.

Table V.- Wisconsin saw timber volume by districts - 1945.

Species	State	Survey districts I	II	III	IV
	Million feet, board measure (lumber tally) 1/				
White pine	930	534	164	204	28
Red pine	300	161	92	40	7
Jack pine	210	50	114	41	5
Hemlock	1,390	711	575	104	-
Balsam fir	170	47	113	10	-
White spruce	200	35	145	20	-
Black spruce	30	13	13	4	-
Tamarack	100	19	14	67	-
Softwood	3,330	1,570	1,230	490	40
Sugar maple	2,290	855	462	689	284
Yellow birch	1,040	399	570	64	7
Basswood	570	173	101	167	129
Beech	170	125	-	45	-
Elm	1,250	348	172	514	216
Oak	3,540	152	117	1,377	1,894
Aspen	1,240	260	407	352	221
Paper birch	310	185	90	15	20
Soft maple	440	114	124	145	57
Miscellaneous better hardwoods	290	24	17	138	111
Miscellaneous Inferior hardwoods	510	105	160	164	81
Hardwood	11,650	2,740	2,220	3,670	3,020
Total	14,980	4,310	3,450	4,160	3,060

1/ Volume of trees over 9 inches d.b.h. contained in logs at least 10 feet long and at least 6 inches minimum diameter for softwood and aspen and 8 inches for hardwood.

Table VI.- Michigan saw timber volume by districts - 1945.

Species	State	Survey districts			
		I	II	III	IV
	Million feet, board measure (lumber tally)[1/]				
White pine	870	225	449	147	49
Red pine	220	60	38	122	-
Jack pine	130	22	23	85	-
Hemlock	4,560	1,108	3,300	150	2
Balsam fir	550	237	280	33	-
White spruce	590	132	447	11	-
Black spruce	370	101	263	6	-
Tamarack	110	45	20	36	9
Softwood	7,400	1,930	4,820	590	60
Sugar maple	5,710	1,650	3,630	340	90
Yellow birch	2,600	755	1,810	35	-
Basswood	1,060	170	610	120	160
Beech	1,170	820	10	270	70
Elm	1,330	158	292	340	540
Oak	880	5	45	60	770
Aspen	1,890	762	275	568	285
Paper birch	380	240	80	60	-
Soft maple	1,060	328	405	57	270
Miscellaneous better hardwood	270	10	8	17	235
Miscellaneous inferior hardwood	390	72	205	13	100
Hardwood	16,740	4,970	7,370	1,880	2,520
Total	24,140	6,900	12,190	2,470	2,580

1/ Volume of trees over 9 inches d.b.h. contained in logs at least 10 feet long and at least 6 inches minimum diameter for softwood and aspen and 8 inches for hardwood.

Table VII - Minnesota Cubic Foot Volume by Districts - 1945 1/

Species	State	Survey districts				
		I	II	III	IV	V
		Millions				
White pine	230	76	81	56	6	11
Red pine	140	30	77	19	5	9
Jack pine	610	368	175	31	7	29
Hemlock	0	0	0	0	0	0
Balsam fir	390	154	143	83	1	9
White spruce	90	22	38	29	1	0
Black spruce	530	227	100	169	4	30
Tamarack	100	6	50	24	6	14
Cedar	310	67	86	139	0	18
Softwood	2,400	950	750	550	30	120
Sugar maple	140	5	51	0	63	21
Yellow birch	20	4	14	0	2	0
Basswood	210	0	73	4	103	30
Beech	0	0	0	0	0	0
Elm	250	10	63	32	85	60
Oak	340	18	32	0	182	108
Aspen	1,850	673	761	156	95	165
Paper birch	430	206	119	64	19	22
Soft maple	30	0	6	3	15	6
Misc. better hardwood	30	4	12	3	9	2
Misc. inferior hardwood	200	30	79	18	57	16
Hardwood	3,500	950	1,210	280	630	430
Total	5,900	1,900	1,960	830	660	550

1/ Volume of trees over 5 inches d.b.h. to a 4 inch minimum top diameter.

Table VIII.- Wisconsin cubic foot volume by districts - 1945. 1/

Species	State	Survey districts			
		I	II	III	IV
		Millions			
White pine	230	128	48	52	2
Red pine	90	46	31	9	4
Jack pine	140	24	60	52	4
Hemlock	340	165	151	24	0
Balsam fir	160	56	89	15	0
White spruce	40	8	25	7	0
Black spruce	30	13	14	3	0
Tamarack	30	11	6	13	0
Cedar	240	109	96	35	0
Softwood	1,300	560	520	210	10
Sugar maple	860	297	214	247	102
Yellow birch	510	185	270	52	3
Basswood	310	80	71	94	65
Beech	70	47	0	23	0
Elm	530	130	84	223	93
Oak	1,490	58	54	562	816
Aspen	960	280	455	145	80
Paper birch	190	91	49	29	21
Soft maple	290	77	86	91	36
Misc. better hardwood	150	13	14	69	54
Misc. inferior hardwood	340	72	113	105	50
Hardwood	5,700	1,330	1,410	1,640	1,320
Total	7,000	1,890	1,930	1,850	1,330

1/ Volume of trees over 5 inches d.b.h. to a 4 inch minimum top diameter.

Table IX - Michigan cubic foot volume by districts - 1945. 1/

Species	State	Survey districts			
		I	II	III	IV
		Millions			
White pine	210	59	89	46	16
Red pine	80	24	8	48	0
Jack pine	130	28	5	97	0
Hemlock	1,190	306	826	58	0
Balsam fir	480	208	233	39	0
White spruce	170	52	110	8	0
Black spruce	190	78	103	9	0
Tamarack	100	47	15	29	9
Cedar	750	358	311	76	5
Softwood	3,300	1,160	1,700	410	30
Sugar maple	1,790	443	1,138	161	48
Yellow birch	820	209	584	23	4
Basswood	380	65	203	74	38
Beech	380	253	5	96	26
Elm	490	53	80	178	179
Oak	430	4	24	139	263
Aspen	1,550	351	301	800	98
Paper birch	250	134	62	50	4
Soft maple	520	175	221	40	84
Mis. better hardwood	120	7	5	27	81
Mis. inferior hardwood	270	56	127	32	55
Hardwood	7,000	1,750	2,750	1,620	880
Total	10,300	2,910	4,450	2,030	910

1/ Volume of trees over 5 inches d.b.h. to a 4 inch minimum top diameter.

Table X.- Total volume of pulpwood species on commercial forest land in the Lake States - 1945.

Species	Total 1/	Sawlog 2/	Standard pulpwood 3/	Substandard pulpwood 4/
		Thousand cords (with bark)		
		REGION		
Spruce	14,000	6,100	7,100	800
Balsam fir	13,700	2,500	9,100	2,100
Jack pine	11,700	5,100	5,300	1,300
Hemlock	20,300	12,600	3,000	4,700
Aspen	58,100	15,300	17,300	25,500
Total	117,800	41,600	41,800	34,400
		MINNESOTA		
Spruce	8,200	3,300	4,400	500
Balsam fir	5,300	800	3,700	800
Jack pine	8,100	4,300	3,100	700
Hemlock	-	-	-	-
Aspen	24,600	7,800	7,000	9,800
Total	46,200	16,200	18,200	11,800
		WISCONSIN		
Spruce	1,000	500	400	100
Balsam fir	2,100	400	1,300	400
Jack pine	2,000	500	1,100	400
Hemlock	4,600	3,000	500	1,100
Aspen	12,800	3,000	3,800	6,000
Total	22,500	7,400	7,100	8,000
		MICHIGAN		
Spruce	4,800	2,300	2,300	200
Balsam fir	6,300	1,300	4,100	900
Jack pine	1,600	300	1,100	200
Hemlock	15,700	9,600	2,500	3,600
Aspen	20,700	4,500	6,500	9,700
Total	49,100	18,000	16,500	14,600

1/ Total volume to a 4 inch top.
2/ Approximate cordwood equivalent of merchantable sawlogs 6 inches and larger in diameter.
3/ Volume of standard pulpwood sticks below sawlog size. Does not include volume in trees containing less than two 8 foot pulpwood sticks
4/ Cull sawlogs, substandard pulpwood sticks and volume in one-stick trees.

Table XI.- Average annual drain 1935-44 by states and species.

Species	Region		Minnesota		Wisconsin		Michigan	
	Cu.ft. 1/	Bd.ft. 2/	Cu.ft.	Bd.ft.	Cu.ft.	Bd.ft.	Cu.ft.	Bd.ft.
	Millions							
White pine	30.4	107.4	10.8	42.3	11.7	36.8	7.9	28.3
Red pine	13.3	49.6	9.5	37.4	2.3	7.6	1.5	4.6
Jack pine	47.7	108.4	28.8	78.0	11.7	19.2	7.2	11.2
Hemlock	111.6	399.7	0	0	61.2	214.5	50.4	185.2
Spruce	37.8	55.6	19.2	26.4	3.2	5.1	15.4	24.1
Balsam fir	23.1	33.5	7.6	9.9	4.3	6.6	11.2	17.0
Tamarack	11.2	16.3	6.2	8.0	3.3	4.7	1.7	3.6
Cedar	16.2	-	3.9	0	4.2	-	8.1	-
All softwood	291.3	770.5	86.0	202.0	101.9	294.5	103.4	274.0
Sugar maple	97.2	327.8	1.8	2.4	26.8	89.4	68.6	236.0
Yellow birch	42.4	143.9	1.5	1.6	17.1	60.0	23.8	82.3
Basswood	22.3	71.0	4.1	9.1	10.1	35.3	8.1	26.6
Beech	8.2	25.5	0	0	0.5	1.4	7.7	24.1
Elm	30.7	84.6	7.3	19.6	10.1	30.6	13.3	34.4
Oak	74.1	140.7	17.3	27.6	36.6	77.4	20.2	35.7
Aspen	84.0	160.2	40.8	78.2	23.3	44.4	19.9	37.6
Paper birch	13.3	24.5	7.7	10.9	1.8	4.0	3.8	9.6
Soft maple	13.5	34.5	1.3	2.9	3.3	8.1	8.9	23.5
Miscellaneous	19.1	35.2	7.2	5.7	5.7	12.0	6.2	17.5
All hardwood	404.8	1047.9	89.0	158.0	135.3	362.6	180.5	527.3
All species	696.1	1818.4	175.0	360.0	237.2	657.1	283.9	801.3

1/ See footnote 4 of table 14.

2/ See footnote 5 of table 14.

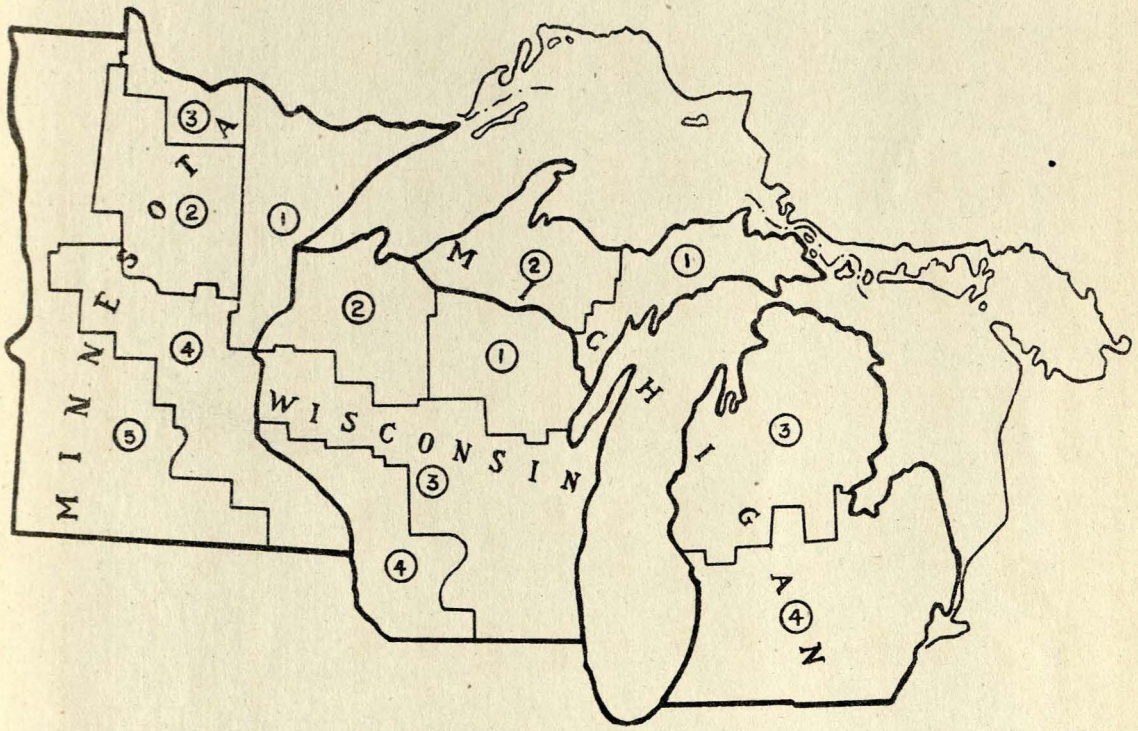
Table XII.- Average annual cordwood drain of pulpwood species 1/ - 1935-1944 inclusive

Species	Region	Minnesota	Wisconsin	Michigan
	Thousand cords (with bark)			
Spruce	370	192	30	148
Balsam fir	226	77	41	108
Hemlock	664	...	380	284
Jack pine	389	210	110	69
Aspen	700	343	185	172
Total	2,349	822	746	781

1/ Excludes sawlog timber but includes low grade cordwood.

Table XIII.- Site classification - area of commercial forest land by type, site, and state - 1945.

Forest type	Good site				Medium site				Poor site			
	Region	Minn.	Wis.	Mich.	Region	Minn.	Wis.	Mich.	Region	Minn.	Wis.	Mich.
	Thousand acres											
White pine	103	30	39	34	392	110	155	127	193	60	64	69
Red pine	102	45	28	29	302	110	85	107	112	25	28	59
Jack pine	474	250	115	109	1,608	740	380	488	1,007	250	269	488
Spruce fir	522	180	120	222	2,035	665	475	895	937	365	197	375
Spruce	436	300	49	87	1,644	1,005	293	346	995	705	146	144
Tamarack	162	100	31	31	1,002	635	168	199	429	245	107	77
Cedar	320	80	44	196	992	360	162	470	317	110	89	118
Northern hardwoods	1,716	60	670	986	4,847	480	1,655	2,712	2,832	650	1,000	1,232
Oak	710	105	470	135	1,740	285	1,050	405	1,495	320	815	360
Ash-elm	560	95	220	245	1,612	465	608	539	841	370	275	196
Aspen	3,031	1,500	646	885	10,627	4,125	3,552	2,950	6,200	1,875	2,260	2,065
All types	8,136	2,745	2,432	2,959	26,801	8,980	8,583	9,238	15,408	4,975	5,250	5,183



Forest-survey districts in the Lake States.